Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	}	
	}	
Revision of Part 15 of the Commission's	}	
Rules Regarding Ultra-Wideband	}	ET Docket No. 98-153
Transmission Systems	}	

PETITION FOR RECONSIDERATION

Filed by: Multispectral Solutions, Inc.
20300 Century Boulevard
Germantown, MD 20874
(301) 528-1745

Date: 14 June 2002

I. BACKGROUND OF THE COMMENTER

Multispectral Solutions, Inc. (MSSI) ("Petitioner") is a recognized industry leader in the development of ultra wideband (UWB) systems for communications, radar and precision geolocation applications. Since its inception in 1989, MSSI has received 65 contract awards to develop and field UWB equipment for the U.S. Government and military. As a consequence, MSSI has extensive experience with the technical issues relating to UWB technology, and is uniquely qualified to provide expert opinion in this Docket.

II. ELIGIBILITY TO PETITION FOR RECONSIDERATION

The Petitioner filed timely comments and reply comments in this docket. Each of the changes requested in this PETITION is eligible for FCC reconsideration under one or more of the following justifications:

(a) The adopted rule significantly changes existing FCC policy, but this change in policy was not proposed by or was not acknowledged in the original Notice of Proposed Rule Making.

(b) The adopted rule is in contradiction with other established FCC rules or with established and continuing FCC policy.

(c) The adopted rule is in material error.

(d) There are additional facts not known or not existing until after the Petitioner's last opportunity to present such matters.

III. THE NEW UWB RULES, TAKEN INTO CONTEXT WITH RECENT FCC ACTIONS, CONFLICT WITH EXISTING PARTS 15.35 AND 15.209 OF THE COMMISSION'S RULES.

In its grant of waivers (15 June 1999) to Time Domain Corporation, U.S. Radar Inc. and Zircon Corporation, the Commission stated that

> "***The specific rules waived are****: Section 15.205(a), which specifies that only spurious emissions may be placed in certain designated restricted frequency bands of operation; and,* ***Sections 15.31 and 15.35 which require the application of a pulse desensitization correction factor when performing certain measurements below 1000 MHz****."* [1] (**Bold** emphasis added.)

[1] FCC Public Notice, "The Office of Engineering and Technology Grants Waivers for Ultra-Wide Band Technologies," FCC 99-1340, 8 July 1999.

Note that §15.35(b) of the Commission's Rules states that

> *"On any frequency of [sic] frequencies above 1000 MHz, the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules, e.g. see Section 15.255. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Measurement of AC power line conducted emissions are performed using a CISPR quasi-peak detector, even for devices for which average radiated emission measurements are specified."*

Thus, the FCC reconfirms in its grant of waivers for UWB technologies that pulse desensitization correction (PDC) is required for emissions *below* 1 GHz; while §15.35(b) further stipulates that measurements (both peak and average) *above* 1 GHz are performed using a minimum resolution bandwidth of 1 MHz with *no mention of a need for pulse desensitization correction.*

Historically, in its Notice of Proposed Rule Making (FCC 87-300) relating to Part 15 devices which first established §15.35, the Commission wrote:

> *"[T]he use of a CISPR quasi-peak detector, as described in CISPR Publication 16, gives a* ***better indication of the interference potential of a signal since it provides a closer***

> ***representation of the power density of the radiated signal****, accounting for the peak emissions."* [2] (**Bold** emphasis added.)

Thus, the FCC also admits that it is the "*power-density of the radiated signal"*, or Watts/Hz, that is a "*better indication of the interference potential*". Furthermore, in the subsequent First Report and Order (FCC 89-103), the Commission states:

> *"[W]e have deleted the requirement that 'suitable adjustment' must be made to the measured results for emissions that are wider than the bandwidth of the measuring instrument. Such adjustments are not needed with the use of CISPR quasi-peak measurements as these measurements* ***determine the permitted emission level per unit bandwidth*** *anywhere within the entire range of frequencies emitted by the Part 15 device. Thus, the* ***measurement procedure is effective in controlling interference potential without a corresponding need to integrate the measured field strength to a high level simply because the Part 15 device is broadbanded****."*[3] (**Bold** emphasis added.)

Again, the Commission confirms that it is unnecessary to integrate the measured field strength, or equivalently, to limit full bandwidth peak power, to protect systems which may be affected by broadband Part 15 devices.

---

[2] FCC 87-300, "Notice of Proposed Rule Making – Revision of Part 15 of the rules regarding the operation of radio frequency devices without an individual license," released October 2, 1987.

[3] FCC 89-103, "First Report and Order – Revision of Part 15 of the Rules regarding the operation of radio frequency devices without an individual license," released April 18, 1989.

Recently, MSSI submitted a UWB device for FCC certification. NTIA tested an early version of this device[4] – Device "A" of the referenced report. With a 1 MHz resolution bandwidth, the MSSI UWB device exhibited an average power which was 35 dB *below* Part 15 limits of 500 ?V/m at 3 meters[5], and exhibited a worst case peak power at 5700 MHz of 75 dB?V/m (5623 ?V/m) at 1 meter; or, equivalently, 1874 ?V/m at 3 meter range[6]. Thus, with a 20 dB peak-to-average ratio limitation as specified in §15.35(b), the UWB device exhibited a peak power which was 8.5 dB *below* Part 15 limits of 5000 ?V/m at 3 meters. The device had a pulse repetition frequency (PRF) of 10 Kpps (10,000 pulses per second).

As the MSSI UWB device had a portion of the main spectral lobe falling within the §15.205(a) restricted band 5.35 to 5.46 GHz; the device was redesigned to operate at a slightly higher operational frequency to stay within the 5.46 to 7.25 GHz non-restricted region. (Note: The original device "A" was also tested by an FCC-certified testing laboratory and MSSI was told that the unit passed §15.209 general emission limits, but failed the §15.205(a) criterion for intentional emissions in restricted bands.)

Upon frequency redesign, the UWB device was again tested by the same laboratory, and MSSI was notified that the unit was now fully compliant with §15.35, §15.205(a) and §15.209. The

---

[4] Kissick, W.A., editor, "The Temporal and Spectral Characteristics of Ultrawideband Signals," U.S. Department of Commerce, NTIA Report 01-383, January 2001.

[5] Kissick, W.A., Figure D.A.23, page D-A-14.

[6] Kissick, W.A., Figure 8.3, page 8-5.

new UWB device has an operational frequency range of 6.1 to 6.6 GHz and an operational PRF of approximately 30 Hz. The unit was tested by the certification laboratory at its worst case PRF of 100 Kpps, which represented a test mode for the device. Final documentation processing for the device for Part 15 certification was scheduled for May 15, 2002.

On 15 May 2002, MSSI was notified by the certification laboratory that the FCC had held a teleconference the day before (on 14 May 2002) with all of its TCBs (Telecommunications Certification Bodies). The FCC notified the TCBs that it was now necessary to take into account pulse desensitization when considering pulsed emissions, regardless of the operational frequency of the device. At that point, MSSI contacted Mr. John Reed from the FCC's Office of Engineering and Technology (OET) for clarification. Mr. Reed indicated that §15.35 was to be interpreted as limiting the *total peak power* for a Part 15 device to -21.25 dBm (*numerically* 20 dB above the -41.25 dBm/MHz average limit), and that this limit was a "full bandwidth" limit. That is, -21.25 dBm represented the total peak power as measured in the full bandwidth of the pulse, not in the "greater than 1 MHz" bandwidth as specified in §15.35(b). Pulse desensitization correction was now necessary for *all* frequencies, irrespective of whether the emission fell above or below 1 GHz.

However, in its First Report and Order (FCC 02-48) for Ultra Wideband technology, the FCC clearly states:

> *"…we believe that our proposal to permit a peak emission within a 50 MHz RBW of only -21.25 dBm EIRP is too conservative. We believe that the peak emission level of 0 dBm/50 MHz, equivalent to 58 mV/m at 3 meters, requested by TDC would not result in harmful interference problems to communications systems. This level translates to a peak EIRP of -24.44 dBm/3 MHz or 3.6 ? W/3 MHz, or to a peak field strength of 3.46 mV/m at [sic] measured at 3 meters with a 3 MHz RBW.* ***This peak level is*** *16.8 dB higher than the average level determined with a 1 MHz RBW and is* ***3.2 dB lower than the peak limit permitted under the current Part 15 rules****."*[7] (**Bold** emphasis added.)

Thus, according to the UWB First Report and Order, 0 dBm/50 MHz peak EIRP is 3.2 dB lower than the peak limit permitted under current Part 15. Indeed, 0 dBm/50 MHz results in a peak field strength of 3,460 ?V/m which is 3.2 dB below the 5,000 ?V/m peak limit imposed by §15.35 *if measured in a 3 MHz bandwidth*. Note that §15.35 only specifies that the bandwidths exceed 1 MHz for measurements.

Now, if §15.35 limits are indeed -21.25 dBm for *total full bandwidth power*, consider a 500 MHz bandwidth UWB signal, the minimum bandwidth required above 3.1 GHz under the new rules. According to the new rules, the peak signal power can be 0 dBm/50 MHz, for a *total full bandwidth power of +20 dBm.* (Note that peak power increases as 20 log bandwidth.) This peak power, according to the FCC's new "interpretation" of §15.35, is ***41.25 dB higher than Part 15 "limits" (-21.25 dBm full bandwidth power).*** This is an obvious contradiction.

---

[7] FCC 02-48, First Report and Order – Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems," adopted February 14, 2002; released April 22, 2002.

Figure 1 graphically illustrates the problem with FCC's 15 May 2002 re-interpretation of §15.35.

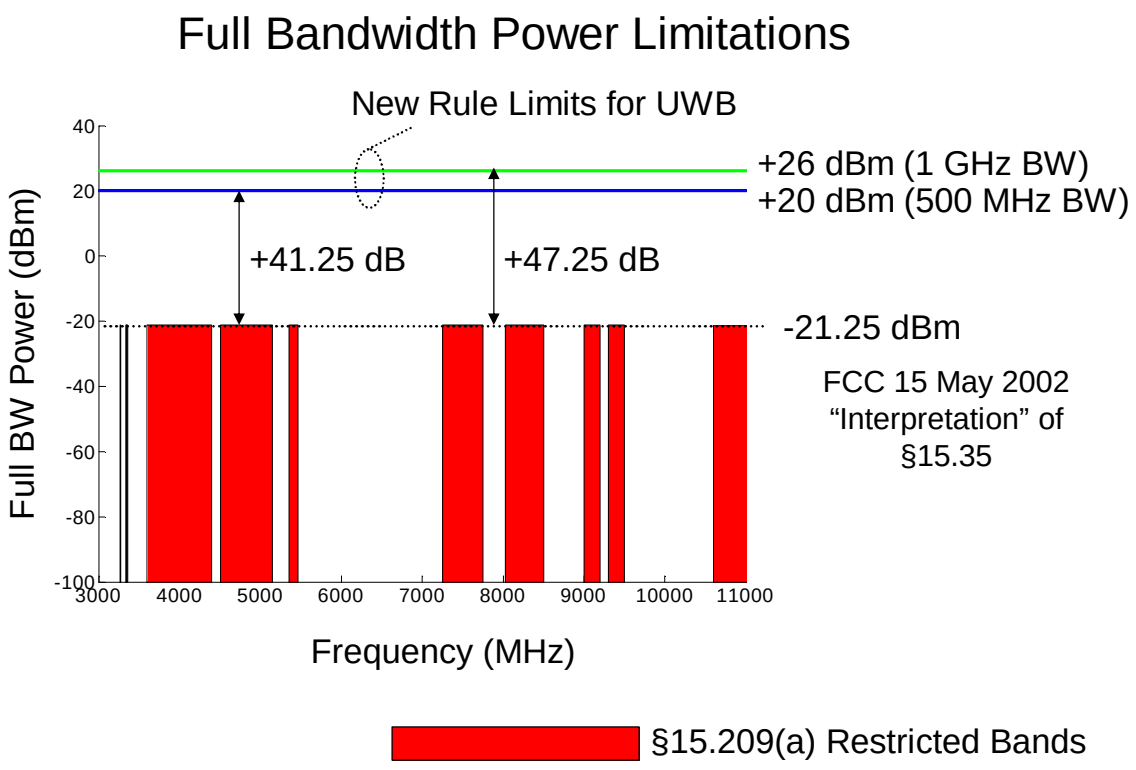

Figure 1. Inconsistencies between FCC re-interpretation of §15.35 and UWB R&O.

Thus**, if pulse desensitization correction is required above 1 GHz, then UWB emissions under the new Subpart F would be a *minimum* of 41.25 dB *or 13,335 TIMES HIGHER THAN EXISTING PART 15 LIMITS WITH THESE HIGHER EMISSIONS NOW OCCURRING IN PREVIOUSLY RESTRICTED BANDS*.** There is not a single comment relating to this issue in the entire UWB proceeding; nor do the FCC's briefing charts on the UWB R&O reflect this interpretation. Concerned spectrum users will indeed be shocked to learn what the actual approved UWB power levels represent. Thus, it must be concluded that the FCC's new "interpretation" of the existing law (i.e., §15.35 and §15.209) is inconsistent with the present UWB First Report and Order.

Proposed Changes

The FCC must not arbitrarily and capriciously re-interpret existing Part 15 regulations, specifically §15.35 and §15.209:

If the FCC now believes that pulse desensitization correction is required *above* 1 GHz, and that -21.25 dBm was the previous Part 15 limit on *full bandwidth peak power*; then the peak power limit of 0 dBm/50 MHz as specified in the UWB First Report and Order is a minimum of 41.25 dB *higher* than that specified in Part 15. To be consistent with Part 15 and the vast record in this proceeding, the FCC must limit the *full bandwidth peak power* of UWB emissions to -21.25 dBm, for there is no discussion in this docket of permitting emission levels (whether peak or average) higher than existing Part 15.

If the FCC wishes to retain the limitation of 0 dBm/50 MHz for UWB emissions as stated in the UWB First Report and Order; then it is imperative that the FCC correctly interpret §15.35(b) as not requiring pulse desensitization correction above 1 GHz. To clarify this issue, the FCC should modify §15.35(b) in the current First R&O to explicitly state this fact. Note that this interpretation would still maintain a limit on peak emissions (i.e., no greater than 20 dB above the maximum average emission), but would measure such emissions appropriately as *peak spectral density* as originally intended in the vast record of documents and testimony related to §15.35.

IV. THE FCC UNNECESSARILY RESTRICTS THE FREQUENCY OF OPERATION FOR LOW PRF UWB APPLICATIONS (E.G., VEHICULAR RADAR)

Given peak power constraints as indicated in §15.509(f), §15.511(f), §15.513(f), §15.515(f),

§15.517(f) and §15.521(g); the lower the pulse repetition frequency (PRF), the lower the average power and, hence, the lower the probability for potential interference to other services. Indeed, as pointed out in numerous submissions into the record from NTIA, Stanford/DOT and others; low PRF systems (particularly those with PRFs less than 100 Kpps[8,9]), were particularly benign to extremely sensitive GPS receivers and had effects considerably less deleterious than even additive white Gaussian noise. Furthermore, as pointed out numerous times to the Commission in this Docket, low PRF UWB systems offer advantages – e.g., low probability of interference, multipath mitigation, high efficiency for extended battery life, etc. – which are virtually unmatched by any other currently available form of wireless technology.[10]

Thus, it makes little sense for the FCC to restrict the operation of low PRF devices, e.g. vehicular radars, in the same region of the spectra (e.g., 3.1 to 10.6 GHz) that it is considering for the use of high-speed communications devices which have been shown to have a significantly higher

---

[8] Anderson, D.S., E.F. Drocella, S.K. Jones and M.A. Settle, "Assessment of Compatibility between Ultrawideband (UWB) Systems and Global Positioning Systems (GPS) Receivers", NTIA Special Publication 01-45, Feb. 2001.

[9] J. Randy Hoffman, Michael G. Cotton, Robert J. Achatz, Richard N. Statz and Roger A. Dalke, "Measurements to Determine Potential Interference to GPS Receivers from Ultrawideband Transmission Systems", NTIA 01-384, Feb. 2001.

[10] Gunderson, S.J. et al., "Naval Total Asset Visibility (NTAV) Precision Asset Location (PAL)," Technical Report TR-2201-AMP, Naval Facilities Engineering Service Center, Port Hueneme, CA, May 2002. This 200+ page report documents the performance of low PRF UWB systems vs. conventional spread spectrum technologies for asset location applications in severe multipath conditions, and contains the results of extensive Government testing of UWB technology in real world environments.

potential for interference. MSSI, NTIA and others have recommended to the Commission that limits be placed on the PRF within certain regions of the spectrum. Indeed, the use of UWB devices – irrespective of their functionality – having PRFs less than 100 Kpps has been demonstrated by the NTIA to pose significantly less of an interference problem than do communications devices, and should be permitted within the 3.1 to 10.6 GHz region.

Furthermore, in its 13 February 2002 submission to this docket, the NTIA states:

> *"Imaging systems, vehicular radar systems, and hand-held systems will be permitted to operate outdoors, provided the emissions in the GPS bands are below the Part 15 general emission limit."* [11]

Thus, the FCC's restriction of UWB vehicular radars to the frequency band 22 – 29 GHz is arbitrary, capricious and without basis in the facts presented to the Commission under the UWB NPRM.

Proposed Changes

Based upon established facts in this proceeding, the FCC should permit the general use of low PRF (<100 kpps) devices, including UWB vehicular radars, within the 3.1 to 10.6 GHz region of the spectrum.

---

[11] "NTIA Summary Analysis of UWB Interference to GPS and Non-GPS Systems," U.S. Dept. of Commerce, National Telecommunications and Information Administration, *ex parte* submission to Docket ET 98-153, 13 February 2002.

V. THE RULES PERMIT THE USE OF OTHER THAN "PULSED EMISSIONS WHERE THE BANDWIDTH IS DIRECTLY RELATED TO THE NARROW PULSE WIDTH"[12], YET THE RECORD CONTAINS NO DISCUSSION OF THE RATIONALE FOR PERMITTING SUCH EMISSIONS

In the UWB NPRM, the FCC stated:

> *"We also request comment on whether we should define UWB devices as limited to devices that solely use pulsed emissions where the bandwidth is directly related to the narrow pulse width. We recognize that other types of modulation, such as linear sweep FM, could be employed to produce UWB equipment. However, we do not believe that we have sufficient information to propose limits and measurement procedures for such systems. Until more experience is gained, we believe that our initial rule making proposals should reflect a conservative approach. In addition, we request comment on whether extremely high speed data systems that comply with the UWB bandwidth requirements only because of the high data rate employed, as opposed to meeting the definition solely from the narrow pulse width, should be permitted."*[1]

No test results were submitted into the record for other than pulsed emissions. Indeed, no data was provided into the record for any systems with greater than an approximate 40 MHz pulse repetition frequency, nor for pulse widths greater than approximately 5 nanoseconds. Hence, all test data fell within the regime for systems in which the bandwidth was completely determined by the narrow pulse width and *not* the data modulation.

---

[12] FCC 00-163, "Notice of Proposed Rule Making – Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems," 11 May 2000.

Thus, the FCC's definition of "Ultra-wideband (UWB) Transmitter" [§15.503(d)], in which a UWB radiator is defined solely by means of its fractional or instantaneous bandwidth irrespective of the nature of the waveform, is inconsistent with the record, and runs contrary to the FCC's desire for a conservative approach as specified in its NPRM.

As a specific example, biphase-modulated, high data rate systems which utilize direct sequence techniques (i.e., high-speed chipping sequences), have not been adequately tested with respect to their potential interference effects.

Proposed Changes

The FCC should modify §15.503(d) to be consistent with the record in this proceeding. Specifically, the wording must exclude "*high speed data systems that comply with the UWB bandwidth requirements only because of the high data rate employed*" as no opportunity to comment on, or to test, such devices was provided in the proceeding. A recommended change to §15.503(d) is as follows:

> *Ultra-wideband (UWB) transmitter.* An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth. Explicitly excluded are devices which achieve wide instantaneous bandwidths because of the use of high data rates; i.e., in which the bandwidth is modulation dependent.

VI. THE NEW RULES CONFLICT WITH SPECTRUM MASKS FURNISHED BY THE FCC ON 14 FEBRUARY 2002

In its 14 February 2002 approval of the First R&O, the FCC supplied a set of spectrum masks which indicated emission limits for various devices approved under the order. For example, the spectral mask for indoor communications systems is shown in Figure 1 below; while the mask for imaging systems is illustrated in Figure 2[13].

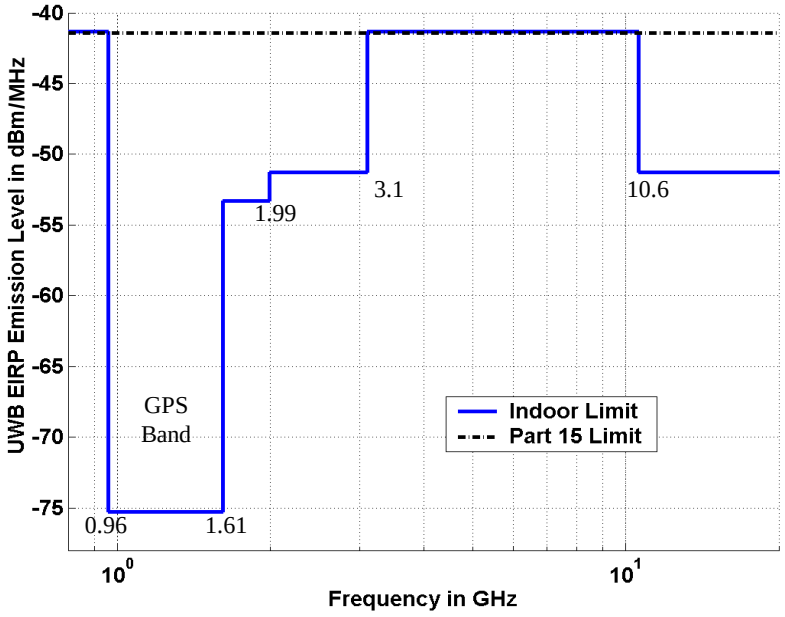

Figure 1. FCC Spectrum Mask for Indoor Communications Systems.

[13] Thomas, E., "Walk don't run – the first step in authorizing ultra-wideband technology," Plenary Session, *2002 IEEE Conference on Ultra Wideband Systems and Technologies*, Baltimore, MD, 20-23 May 2002.

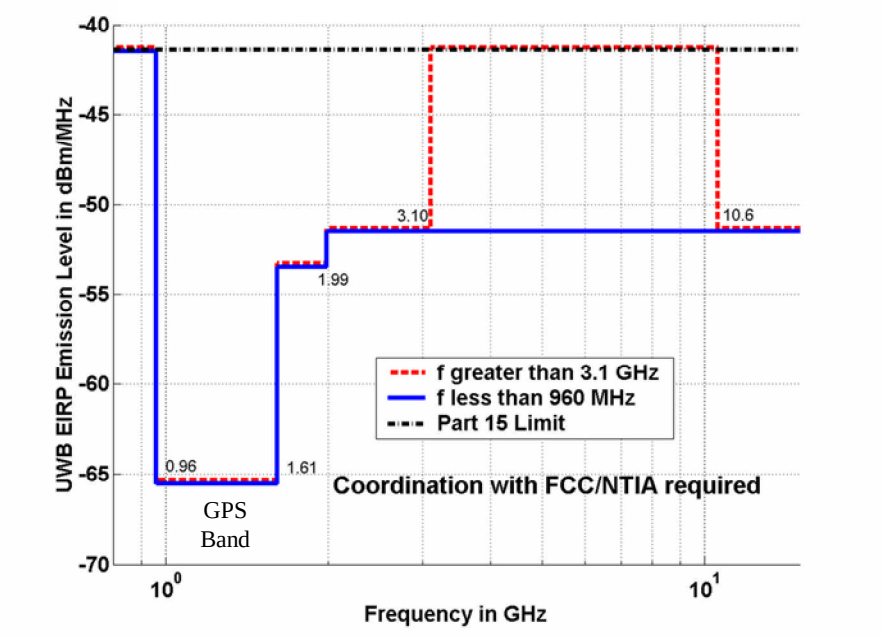

Figure 2. FCC Spectrum Mask for GPRs, Wall Imaging, & Medical Imaging Systems.

Note that, in all cases, only a single limit (500 ?V/m, or -41.25 dBm/MHz) was specified below 960 MHz.

However, this is inconsistent with the R&O wherein it is stated [e.g., §15.509(d), §15.511(d), §15.513(d), §15.515(d), §15.517(c) and §15.519(c)] that

> *"The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209 of this chapter."*

§15.209(a) specifically states that the emissions from an intentional radiator operating below 960 MHz must not exceed the following maximum field strengths:

Frequency (MHz)	Field Strength (?V/m)?	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3

Thus, for example, in the frequency range 216 to 960 MHz, §15.209(a) specifies that the emissions must be 8.0 dB *lower* than as specified in the Subpart F FCC spectrum masks. In the 30 to 88 MHz portion of the spectrum, emissions must be 14.0 dB *lower*.

Proposed Changes

While it may have been the FCC's intent to increase §15.209(a) general emission limits below 960 MHz, nothing in the record has been provided to support this increase. Thus, the FCC should clarify that the charts provided by OET do not correctly reflect the wording of Subpart F. To prevent confusion, it is recommended that the FCC explicitly include the above table in Subpart F.